



Translation of

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Herewith, we confirm that this English translation is verified
by a German patent attorney.

Munich, September 28, 2005

A handwritten signature in black ink, appearing to be "Armin Kühn".

Armin Kühn
Patent Attorney



Anwaltskanzlei
VIFRING, JENTSCHURA & PARTNER
Steindelfstr. 6, 80538 München

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- The invention relates to a cleaning device for tube-type heat exchangers, with an inflow line constituting
5 the cooling-water supply line, with an outflow line, with a distributor for rubber cleaning globules which is arranged in the inflow line, with a collection device provided in the outflow line and intended for collecting the globules, with a collecting container
10 connected to the distributor, with a separator which is connected to the collecting container, and with a circulating pump conveying the globules through the distributor into the inflow line.
- 15 In steam-power machines, condensers condense the exhaust steam in that cooling water is conducted through a number of tube groups. In this case, a large quantity of cooling water, for example river or sea water, is required, which has to be conveyed by
20 cooling-water pumps. Means for eliminating the contamination are provided for the cooling-water ducts, but it is scarcely possible to achieve complete cleaning. The water generally contains tiny foreign substances which, during lengthy operation, accumulate
25 on the walls of the tubes of a condenser. Even if only a small quantity of such impurities adheres to the tube walls, this diminishes the heat transition coefficient. The manometric pumping head with the cooling water running through likewise increases, and therefore the
30 aim is to keep the tubes as clean as possible at all times.

A known cleaning device of this generic type mentioned in the introduction is constructed in such a way that
35 the rubber globules are fed into the cooling water before the entry of water into the condenser and are flushed through the tubes, whereupon they are collected downstream of the water exit chamber and are returned to the delivery point; a circulation of the rubber

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globules thus takes place. In this case, to circulate the rubber globules, a circulating pump is used which conveys the rubber globules together with part of the cooling water. This, however, results in disturbances, 5 since the cross section for the passage of the water is restricted at the blade wheel of the circulating pump, as also the rubber globules have to flow through. This presents difficulties in the design of the circulating pump and, moreover, leads to a high wear in terms of 10 rubber globules. Furthermore, there is the disadvantage that, in the event of the failure or repair of the circulating pump, the entire cleaning device is inoperative.

15 Furthermore, a cleaning device for keeping liquid-flushed surfaces clean in heat exchanger distillations is known, in which two suspended-body containers arranged in parallel are located between the inflow and the outflow. By means of periodically reversible 20 changeover valves, the direction of flow in each container is in each case reversed. In this arrangement, there is no need for a specific circulating pump, but, instead, the pressure differences caused by the cooling-water pump are 25 utilized for the return of the suspended bodies. If, then, the heat exchange operation between the steam and the cooling water in the heat exchanger takes place with a low throughput quantity, that is to say with a low cooling-water throughflow quantity, the pressure 30 difference between the inflow line and the outflow line is slight. The pressure difference between the lines connected to the suspended-body containers then decreases correspondingly sharply, and the feedback of the suspended bodies to the inflow line is consequently 35 made more difficult and is reduced.

The object of the present invention is to provide a cleaning device, in which there is a reliable and load-independent circulation of the rubber globules, without

these at the same time having to run through the circulating pump provided. The device is to be constructed in a simple way and is to be easy to maintain, and a commercially available circulating pump is to be capable of being used instead of a special design.

10 This object is achieved, according to the invention in that the collecting container is connected to the separator via a non-return valve, and the circulating pump can be connected alternately to the collecting container and the separator by means of a branched pressure line and is connected to the inflow line by means of the suction line.

15 This affords the advantage that the heat exchanger can be operated with the full effect of the cleaning operation under any load and in the case of a high and a low throughput quantity. The cleaning device is therefore fully load-independent. The risk of damage to the rubber globules is decisively reduced. The selected power of the pump can advantageously be very low, since the blade wheel no longer has to be dimensioned with a view to the passage of the rubber globules.

25 According to one embodiment of the invention, a throttle device is arranged in the inflow line between the distributor and the branch-off of the suction line, and a circulation line bridging the circulating pump is provided between the suction line and the pressure line. As a result, in the event of a failure of the circulating pump, cooling water can be supplied alternately to the collecting container and the separator by the actuation of the throttle valve and of valves provided correspondingly in the pressure-line branches, and the rubber globules can thus be conducted to the distributor. The circulation of the rubber globules can thus be obtained to a minimum extent even in the event of an operating fault in the circulating

pump.

The invention is described in more detail below by means of an exemplary embodiment illustrated in the drawing. The drawing shows a diagram of the arrangement
5 of the cleaning device according to the invention.

The inflow line, which constitutes the cooling-water supply line from a river or from the sea, is designated by 1. The outflow line emanating from the condenser 3
10 is designated by 2. The condenser 3 is provided with the cooling-water tube bundles 6 located in the steam space 8 which is connected to the exhaust-steam connecting piece of a low-pressure steam turbine, the cooling water flowing through the tubes 6. An entry
15 water chamber connected to the inflow line 1 is designated by 4, whilst 5 denotes an exit water chamber connected to the outflow line 2 for the cooling water. A transversely arranged water chamber which connects the individual tube bundles to one another and likewise
20 the entry chamber 4 to the exit chamber 5 is designated by 7. This version corresponds to that extent to a general condenser design.

The cleaning device according to the invention, then,
25 is to flush through and sweep the cooling-water ducts in a condenser of the above design; it is designed as follows:

9 is a distributor for introducing the rubber globules
30 in the inflow line 1; 10 is a collecting device for collecting the rubber globules after these have passed through the condenser tubes. This collecting device consists of a wire fabric or of perforated metal sheets and is in the form of a funnel which is connected at
35 its lower end to a pipe 23 for discharging the rubber globules. 11 is a separator which is connected to the collector 10 by means of the connecting pipe 23. Located in this separator is a filter plate for separating the cooling water; it is connected by means

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of an outflow pipe 24 to the outflow line 2, by means of a pipe 25 to the circulating pump 13 and by means of a non-return valve 16 to a collecting container 12 which stores the rubber globules before these enter the distributor. This collecting container 12 is connected by means of a non-return valve 17, a pipe 26 and a shut-off valve 21 to the circulating pump 13, so that the latter can convey cold pressure water into the collecting container and feed the rubber globules under pressure to the distributor 9, from where the globules pass into the inflow line 1. The collecting container 12 is provided with a closing cover, in order to make it easier to inspect or exchange the rubber globules located in it, that is to say by the removal of the cover when the cleaning device is not in operation.

13 is the circulating pump for conveying the cooling-water part-stream transporting the rubber globules; the individual non-return valves 14, 15, 16, 17 and 18 and the shut-off valves 19, 20, 21 and 22 serve for conducting the stream correspondingly. The circulating pump is connected by means of its suction connection piece to the suction line 27 and by means of its delivery connection piece, via the shut-off valves 22 and 21, to the pipes 25 and 26. If, then, the valve 21 is opened and the valve 22 closed, the cooling water conveyed by the circulating pump 13 passes through the pipe 26 into the collecting container 12 and, together with the rubber globules located in the latter, into the distributor 9 and from the latter into the inflow line 1; backflow is prevented by a non-return valve 14.

In this operating phase, the rubber globules collected from the outflow line 2 by means of the collecting device 10 pass through the connecting pipe 23 into the separator 11 which is at this time separated from the circulating pump and which is fed with cooling water from the collecting device 10, the globules being retained in the separator, whilst the cooling water

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returns through the outflow pipe 24 and the shut-off valve 28 to the outflow line 2. The connecting pipe 23, the separator 11 and the outflow pipe 24 form a secondary path system to the outflow line 2. When the rubber globules accumulated in the separator are to be circulated again, the shut-off valve 21 arranged in the pipe 26 is closed and the shut-off valve 22 provided in the pipe 25 is opened, whilst the shut-off valve 28 located in the outflow pipe 24 is closed. The cooling water is then conveyed by the circulating pump 13 into the separator 11, the rubber globules located in the latter being pressed through the non-return valve 16 into the collecting container 12 by the pressure of the cooling water, and at the same time some of these may pass into the distributor pipe 9; in this case, the water supply to the pipes 26 and 23 is shut off by means of the non-return valves 17 and 15. During this operation, the secondary path system is out of operation, but the collecting of the globules by the collecting device 10 continues. When all the rubber globules have been pressed out of the separator 11 into the collecting container 12, the shut-off valve 21 is opened, whilst the shut-off valve 22 is closed, whereupon, as described above, the operation of distributing and collecting the rubber globules can be pursued.

In the version specified above, the distribution of the rubber globules took place solely by means of the cooling water conveyed by the circulating pump 13. If a throttle valve 29 is additionally built into the inflow line 1 between the connection points for the distributor 9 and the suction line 27 for the purpose of throttling the cooling-water stream, the resulting pressure difference can be utilized for conveying the rubber globules and, in the event of an operating fault, the circulating pump can be bypassed. In this case, the cooling water flows out of the suction line 27 through a circulation line 30 and the shut-off

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valves 20 and 22 and 21 to the separator 11 or
collecting container 12.

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Patent claims:

1. Cleaning device for tube-type heat exchangers,
with an inflow line constituting the cooling-water
5 supply line, with an outflow line, with a distributor
for rubber cleaning globules which is arranged in the
inflow line, with a collecting device provided in the
outflow line and intended for collecting the globules,
with a collecting container connected to the
10 distributor, with a separator which is connected to the
collecting container, and with a circulating pump
conveying the globules through the distributor into the
inflow line, characterized in that the collecting
container (12) is connected to the separator (11) via a
15 non-return valve (16), and the circulating pump (13)
can be connected alternately to the collecting
container (12) and the separator (11) by means of a
branched pressure line (pipes 25, 26) and is connected
to the inflow line (1) by means of the suction line
20 (27).

2. Cleaning device according to Claim 1,
characterized in that a throttle device (29) is
arranged in the inflow line (1) between the distributor
25 (9) and the branch-off of the suction line (27), and a
circulation line (30) bridging the circulating pump
(13) is provided between the suction line (27) and the
pressure line.